Introduction to Sustainment Management Systems

U.S. Army Corps of Engineers

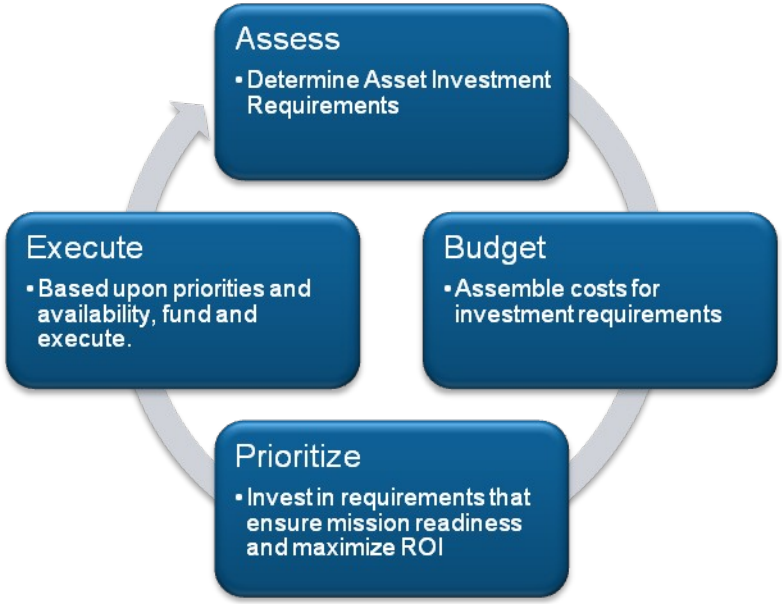
Engineer Research & Development Center

Construction Engineering Research Lab

Engineered Asset Lifecycle Management Tools

Provide objective facility investment guidance to:

- **Systematic assessment to identify maintenance requirements for increased reliability**
- **Analyze investment timing to optimize return on investment**
- **Prioritize scarce resources according to economic and mission priorities**
- **Predict the effects/consequences of decisions to ensure mission readiness**

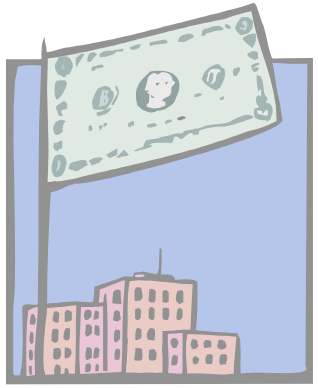

Assess
• Determine Asset Investment Requirements
Budget
• Assemble costs for investment requirements
Prioritize
• Invest in requirements that ensure mission readiness and maximize ROI
Execute
• Based upon priorities and availability, fund and execute.

THE DESIRED RESULTS

Sustainment Management Systems

Better management of the sustainment, restoration, and modernization of our infrastructure

- **Assessments that are systematic, objective, and efficient**
- **Decision information that supports the mission needs of your infrastructure**
- **Optimizes the use of scarce resources**
- **Informs the consequences of decisions to avoid future shocks**



Only gather as much information as is absolutely necessary to make the decision immediately in front of you.

SMS Applications

Sustainment Management Systems

	BUILDER for all Building Components	Used by Army, Air Force, Marine Corps, Navy, FBI, DOE, NASA, and others
	PAVER for Airfields and Roads	Used by Army, Air Force, Navy, Marine Corps, and airports worldwide
	RAILER for Track	Used by Army, Air Force, Navy, Marine Corps, and others
	ROOFER for Roofing	Used by Army, Air Force, Navy, and others

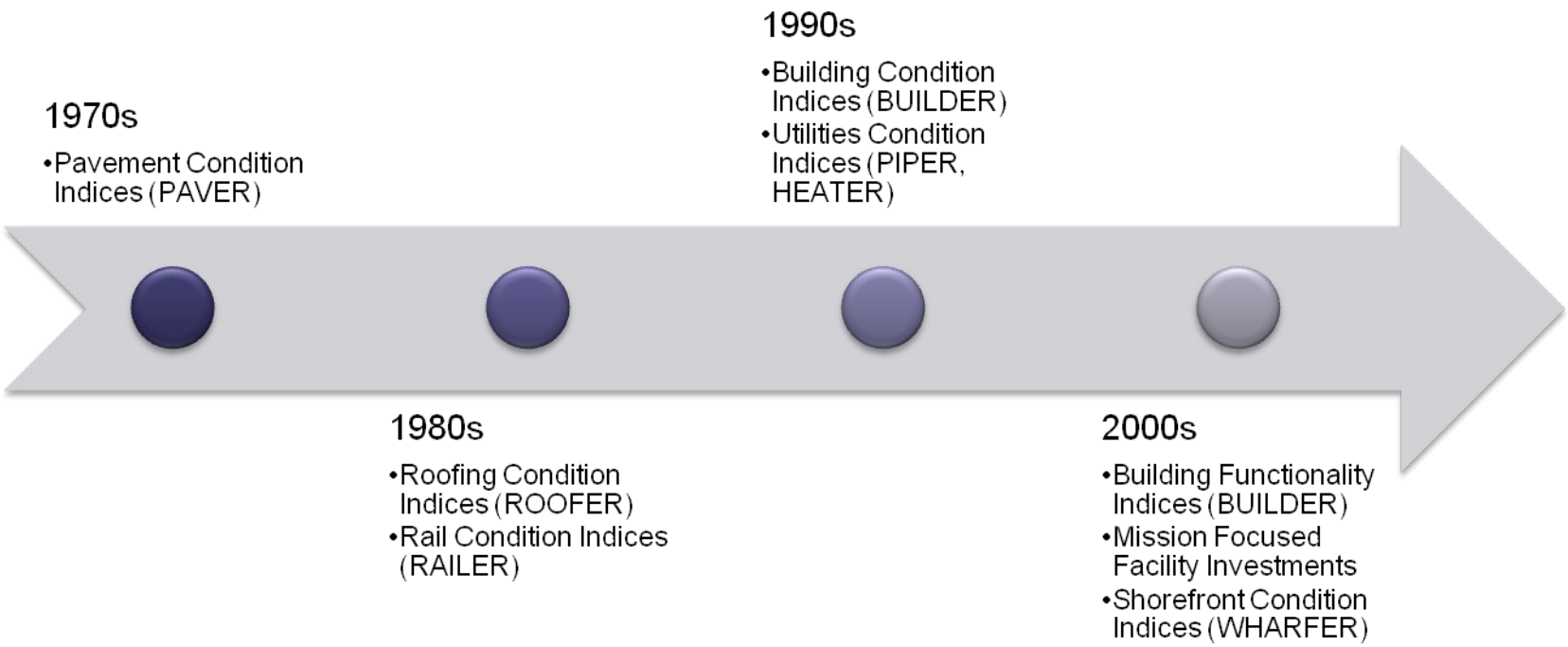
The following additional technology and products are available in various stages of technology readiness: WHARFER, WALKER, GPIPER, WPIPER, & HEATER.

SMS Products are also available to the private sector through multiple technology transfer partners.

Agenda/Outline

- Introduction
- History
- Inventory
- Assessment
- Prediction
- Work Planning
- Forecasting/Analysis
- GIS
- Integration
- Summary Discussion

EMS/SMS Development History



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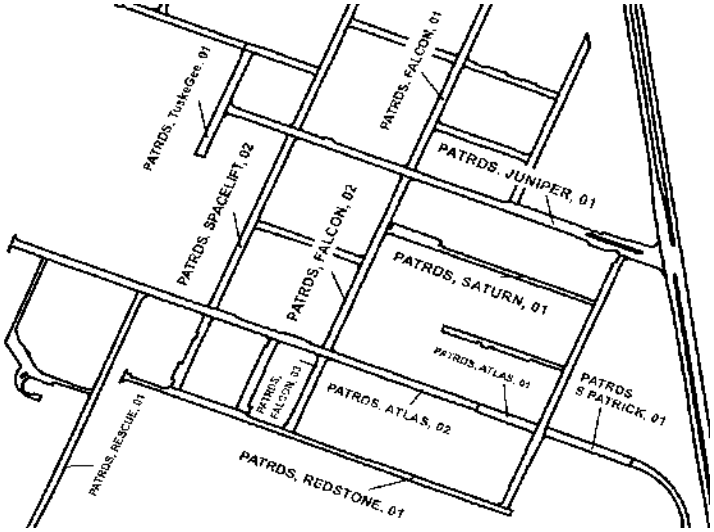
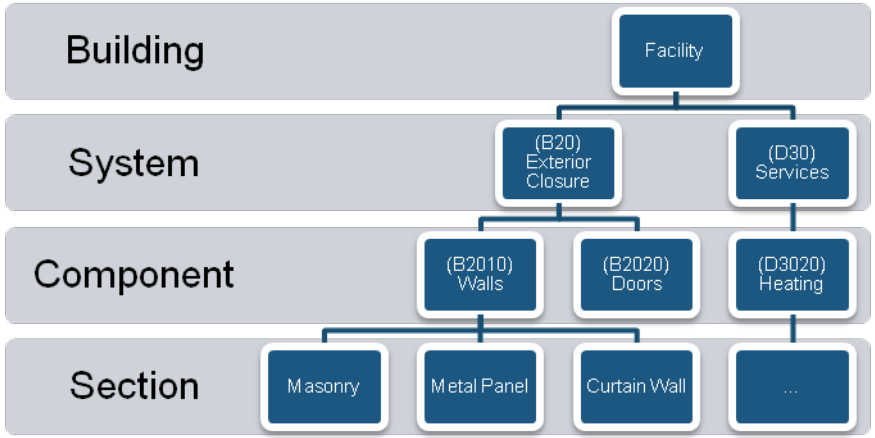
Inventory

- **Identify “building blocks” of facilities that will be independently maintained**
  - **City blocks for roads**
  - **runways, aprons, and taxiways for airfields**
  - **segment of railroad track**
  - **Doors, walls, windows, roof, etc. of building**
- **Capture just enough detail to accurately reflect replacement values and service lives**

Road Network



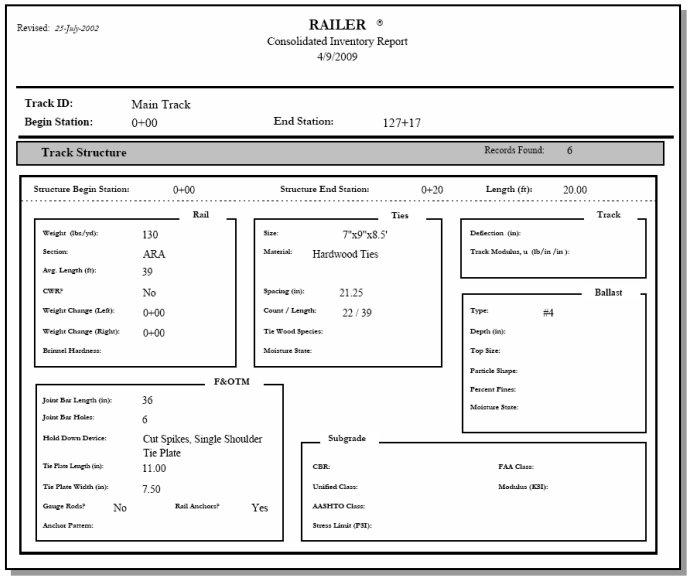
Building Hierarchy



Inventory Results

- **Inventory models aligned with RPI requirements**
  - **RP Site ID**
  - **RP UID**
  - **(Future) RP Equipment ID**
- **Detailed inventory can form basis for Real Property**
  - **Quantity**
  - **FAC Type**
  - **Age**
  - **MDI**
  - **Etc.**

System	Component	Section Description	Quantity (UM)	Yr. Installed	Yr Painted
Conveying	Elevator	Electric Freight 2 Stops	1 (EA)	2007	
Electrical	Distribution	Electrical Category 1	13,000 (SF)	2007	
	Generator Set	Gasoline <35 KW	1 (EA)	2007	
	Intruder Detection/Security	Intrusion	1 (EA)	2007	
	Lighting Fixtures	Fluorescent Interior	425 (EA)	2007	
Exterior Closure	Exterior Door	Glass Personnel	6 (EA)	2007	
	Exterior Wall	Masonry Face Brick w/ CMU Backup	5,268 (SF)	2007	
	Exterior Window	Metal Casement	57 (EA)	2007	
Fire Suppression	Fire Suppression	Sprinkler (Ordinary Hazard) Wet	13,000 (SF)	2007	
HVAC	Cooling and Heating Unit	Rooftop AC (Single Zone) 10 TN Elec. Cool, 200 MBH Gas Heat	1 (EA)	2007	



Revised: *25-July-2002*

RAILER ®
Consolidated Inventory Report
4/9/2009

Track ID: Main Track
Begin Station: 0+00 **End Station:** 127+17

Track Structure Records Found: 6

Structure Begin Station: 0+00 Structure End Station: 0+20 Length (ft): 20.00

Rail
Weight (lbs/yd): 130
Section: ARA
Avg. Length (ft): 39
CWR? No
Weight Change (Left): 0+00
Weight Change (Right): 0+00
Brinnel Hardness:

Ties
Size: 7"x9"x8.5'
Material: Hardwood Ties
Spacing (in): 21.25
Count / Length: 22 / 39
Tie Wood Species:
Moisture State:

Track
Deflection (in):
Track Modulus, u (lb/in /in):

Ballast
Type: #4
Depth (in):
Top Size:
Particle Shape:
Percent Fines:
Moisture State:

F&OTM
Joint Bar Length (in): 36
Joint Bar Holes: 6
Hold Down Device: Cut Spikes, Single Shoulder Tie Plate
Tie Plate Length (in): 11.00
Tie Plate Width (in): 7.50
Gauge Rods? No Rail Anchors? Yes
Anchor Pattern:

Subgrade
CBR:
Unified Class:
AASHTO Class:
Stress Limit (PSI):
FAA Class:
Modulus (KSI):

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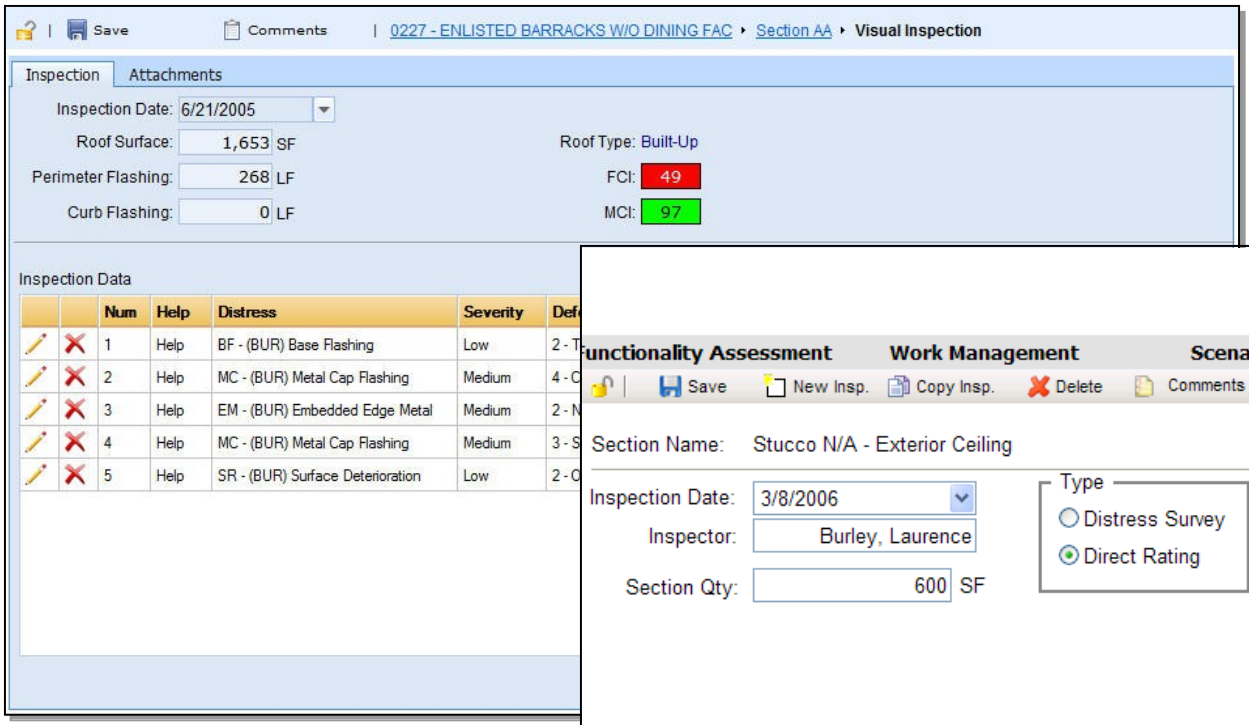
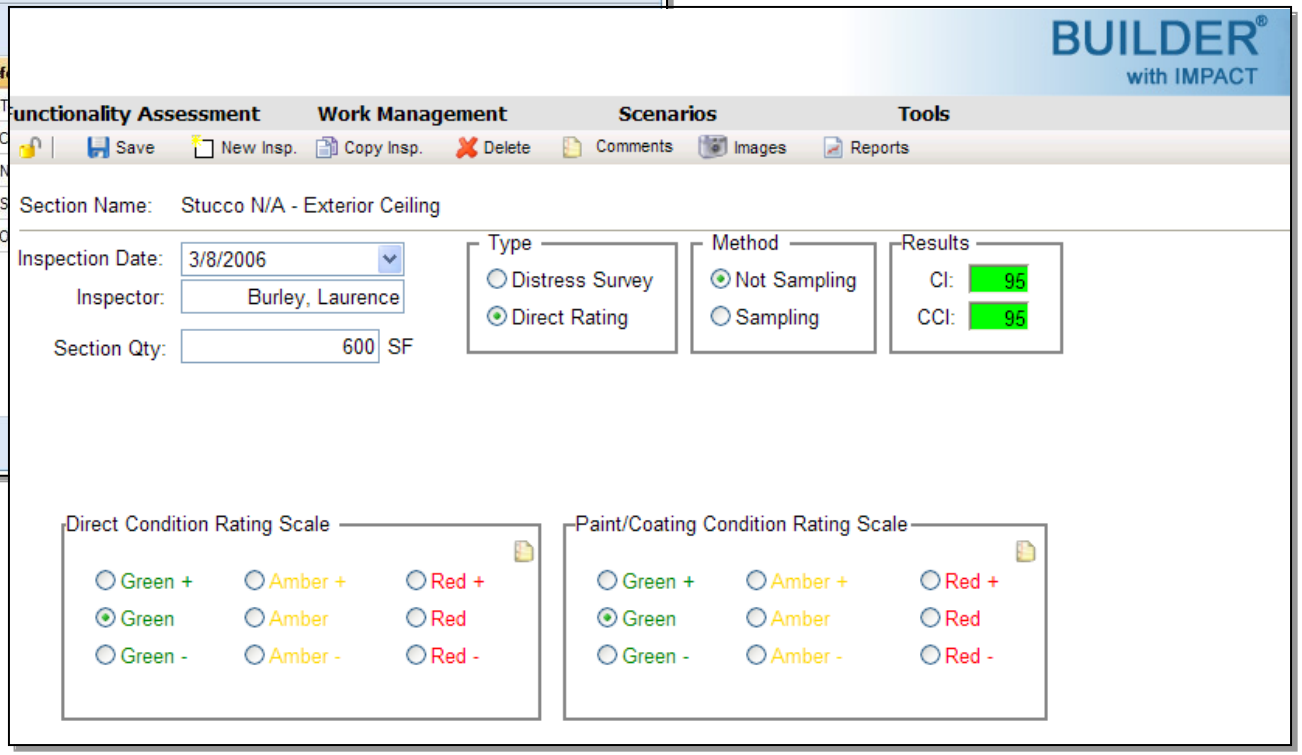
Assessment

- **Designed to accommodate the different inspection purposes (risk management, condition reporting, work development)**
- **Standardized process costs much less than traditional engineering evaluations**
  - **Models the rating that would be given by a group of experts.**
  - **Standardization increases consistency and quality of information across organization (apples-to-apples)**
  - **Cost savings vary by asset class**

Condition Assessment


Save
Comments
0227 - ENLISTED BARRACKS W/O DINING FAC ▸ Section AA ▸ Visual Inspection
Inspection
Attachments
Inspection Date: 6/21/2005
Roof Surface: 1,653 SF
Perimeter Flashing: 268 LF
Curb Flashing: 0 LF
Roof Type: Built-Up
FCI: 49
MCI: 97
Inspection Data
Num
Help
Distress
Severity
1 Help BF - (BUR) Base Flashing Low
2 Help MC - (BUR) Metal Cap Flashing Medium
3 Help EM - (BUR) Embedded Edge Metal Medium
4 Help MC - (BUR) Metal Cap Flashing Medium
5 Help SR - (BUR) Surface Deterioration Low

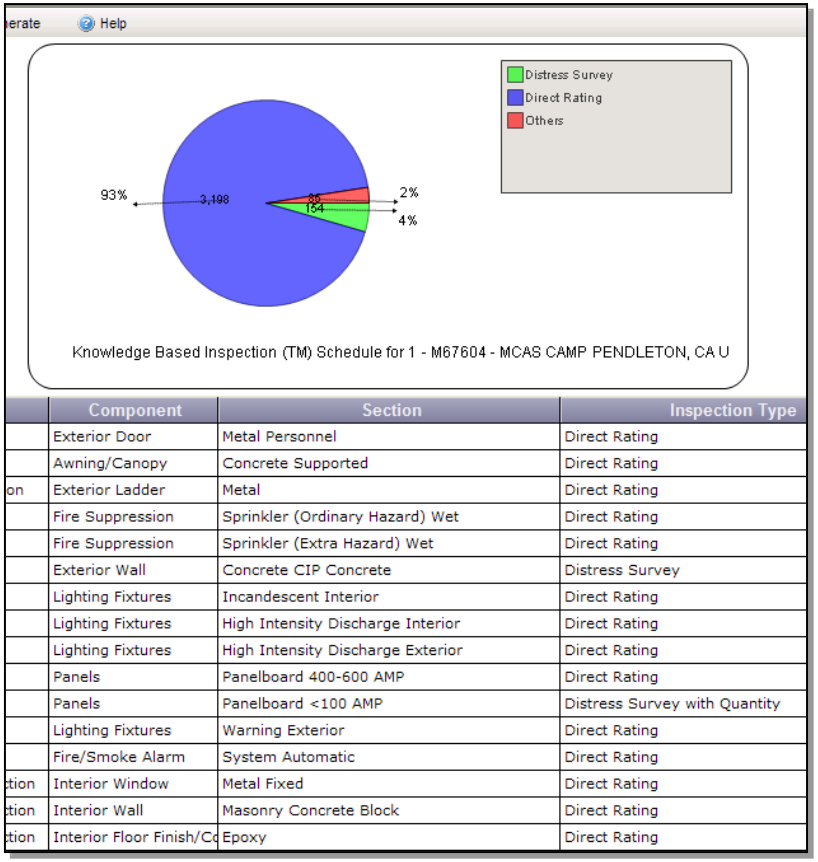


Preset choices for values and consistent definitions result in standardized, objective scores regardless of inspector

Knowledge Based Inspection

Sustainment Management Systems

- **An asset does not require the same level of scrutiny at all points in its lifecycle.**
- **Focus inspection attention and resources on what's important, considering risk.**
- **Tailor the frequency and level of detail to the purpose and lifecycle condition.**



	Component	Section	Inspection Type
	Exterior Door	Metal Personnel	Direct Rating
	Awning/Canopy	Concrete Supported	Direct Rating
on	Exterior Ladder	Metal	Direct Rating
	Fire Suppression	Sprinkler (Ordinary Hazard) Wet	Direct Rating
	Fire Suppression	Sprinkler (Extra Hazard) Wet	Direct Rating
	Exterior Wall	Concrete CIP Concrete	Distress Survey
	Lighting Fixtures	Incandescent Interior	Direct Rating
	Lighting Fixtures	High Intensity Discharge Interior	Direct Rating
	Lighting Fixtures	High Intensity Discharge Exterior	Direct Rating
	Panels	Panelboard 400-600 AMP	Direct Rating
	Panels	Panelboard <100 AMP	Distress Survey with Quantity
	Lighting Fixtures	Warning Exterior	Direct Rating
	Fire/Smoke Alarm	System Automatic	Direct Rating
tion	Interior Window	Metal Fixed	Direct Rating
tion	Interior Wall	Masonry Concrete Block	Direct Rating
tion	Interior Floor Finish/Co	Epoxy	Direct Rating

Inspections are scheduled based on a logical set of business rules, not just by year.

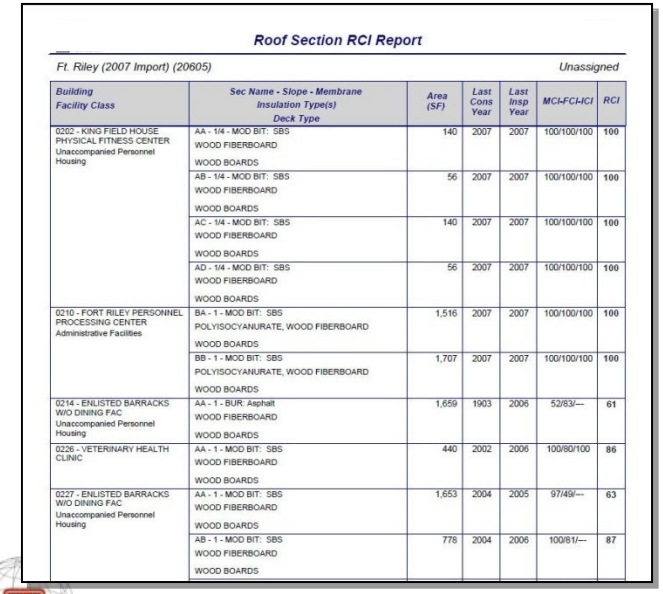
Functionality Assessment

- **Modernization inspection addresses issues of:**
  - **Capacity (too little or too much)**
  - **Configuration**
  - **Change in user requirements**
  - **Technical obsolescence**
  - **Regulatory/code compliance**
- **Available at building, space, and component levels**
- **Can simulate mission change to determine investment requirements for future occupants**

Issue	Issue FI	Last Assessment
Location	100	02/21/2007
Building Size and Configuration	100	02/21/2007
Structural Adequacy	100	02/21/2007
Access	100	02/21/2007
ADA	100	02/21/2007
ATFP	100	02/21/2007
Building Services	100	02/21/2007
Comfort	100	02/21/2007
Efficiency and Obsolescence	100	02/21/2007
Environmental/Health	100	02/21/2007
Missing or Improper Components	100	02/21/2007
Aesthetics	100	02/21/2007
Maintainability	100	02/21/2007
Cultural Resources		

Assessment Results

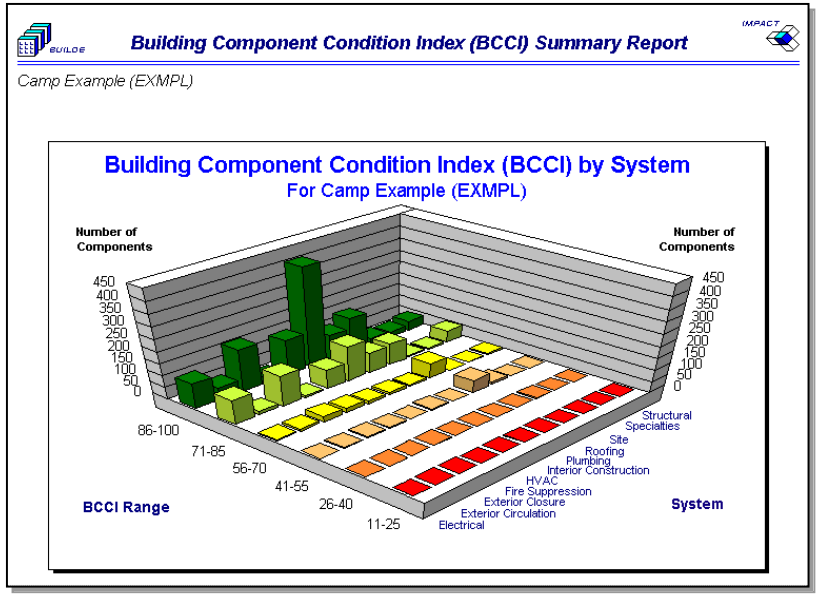
- **Readiness Reporting (Condition, or Quality)**
- **Condition for discrete, real-world elements that can be specifically repaired or replaced by SRM investments (traceability and accountability).**
- **Cost-effective, objective, repeatable metric that forms the foundation for forecasting, work requirements, budgeting, and prioritization.**



Roof Section RCI Report

Ft. Riley (2007 Import) (20605) — *Unassigned*

Building Facility Class	Sec Name - Slope - Membrane Insulation Type(s) Deck Type	Area (SF)	Last Cons Year	Last Insp Year	MCI-FCI-ICI	RCI
0202 - KING FIELD HOUSE PHYSICAL FITNESS CENTER Unaccompanied Personnel Housing	AA - 1/4 - MOD BIT: SBS WOOD FIBERBOARD WOOD BOARDS	140	2007	2007	100/100/100	100
	AB - 1/4 - MOD BIT: SBS WOOD FIBERBOARD WOOD BOARDS	56	2007	2007	100/100/100	100
	AC - 1/4 - MOD BIT: SBS WOOD FIBERBOARD WOOD BOARDS	140	2007	2007	100/100/100	100
	AD - 1/4 - MOD BIT: SBS WOOD FIBERBOARD WOOD BOARDS	56	2007	2007	100/100/100	100
0210 - FORT RILEY PERSONNEL PROCESSING CENTER Administrative Facilities	BA - 1 - MOD BIT: SBS POLYISOCYANURATE, WOOD FIBERBOARD WOOD BOARDS	1,516	2007	2007	100/100/100	100
	BB - 1 - MOD BIT: SBS POLYISOCYANURATE, WOOD FIBERBOARD WOOD BOARDS	1,707	2007	2007	100/100/100	100
0214 - ENLISTED BARRACKS W/O DINING FAC Unaccompanied Personnel Housing	AA - 1 - BUR: Asphalt WOOD FIBERBOARD WOOD BOARDS	1,659	1903	2006	52/83/---	61
0226 - VETERINARY HEALTH CLINIC	AA - 1 - MOD BIT: SBS WOOD FIBERBOARD WOOD BOARDS	440	2002	2006	100/80/100	86
0227 - ENLISTED BARRACKS W/O DINING FAC Unaccompanied Personnel Housing	AA - 1 - MOD BIT: SBS WOOD FIBERBOARD WOOD BOARDS	1,653	2004	2005	97/49/---	63
	AB - 1 - MOD BIT: SBS WOOD FIBERBOARD WOOD BOARDS	778	2004	2006	100/81/---	87



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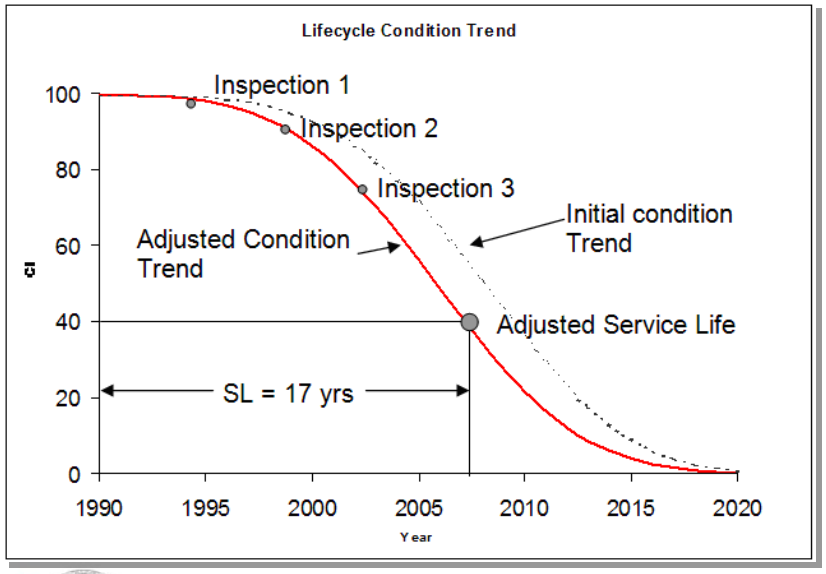
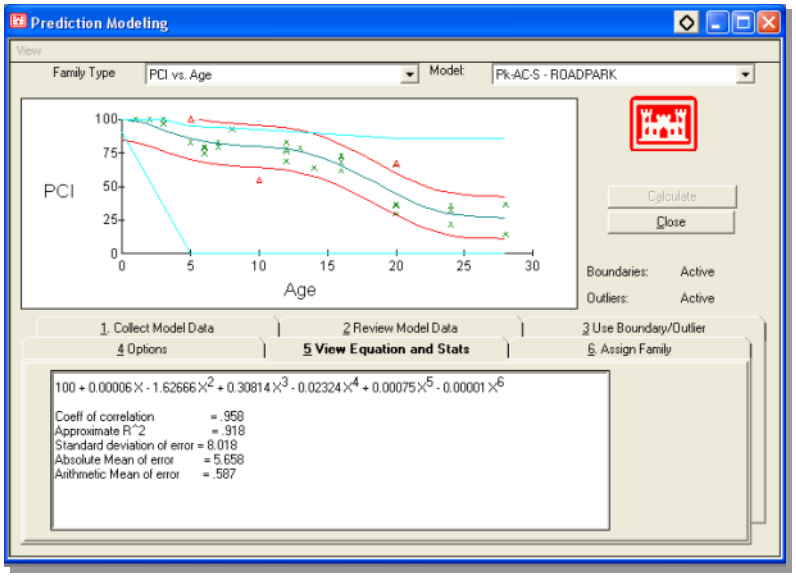
Condition Analysis/Prediction

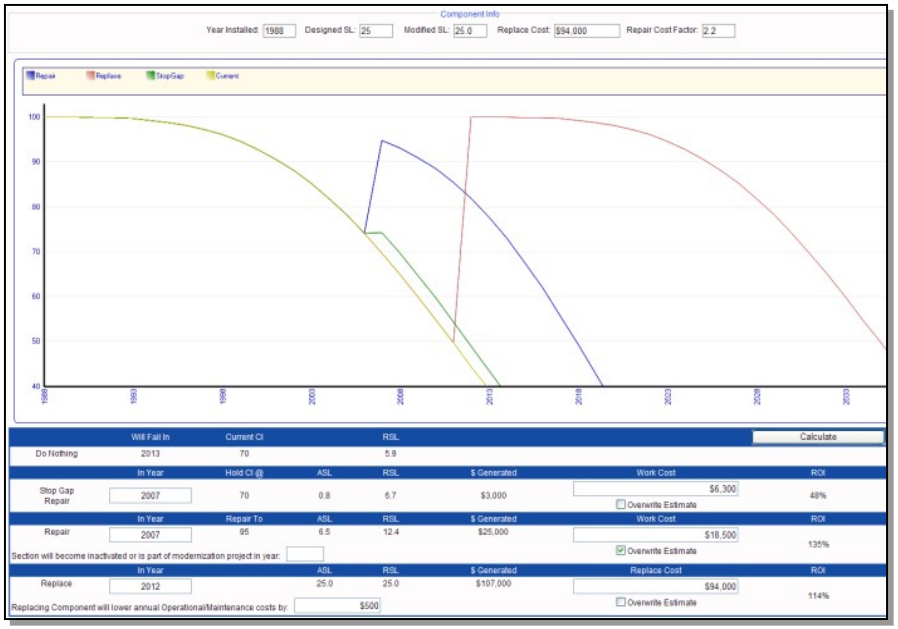
- **Objective CI metric provides basis for being able to predict condition over time.**
- **Several scientific, patent-pending methods generate a projected CI at any time, without the need to perform new assessments each and every year.**

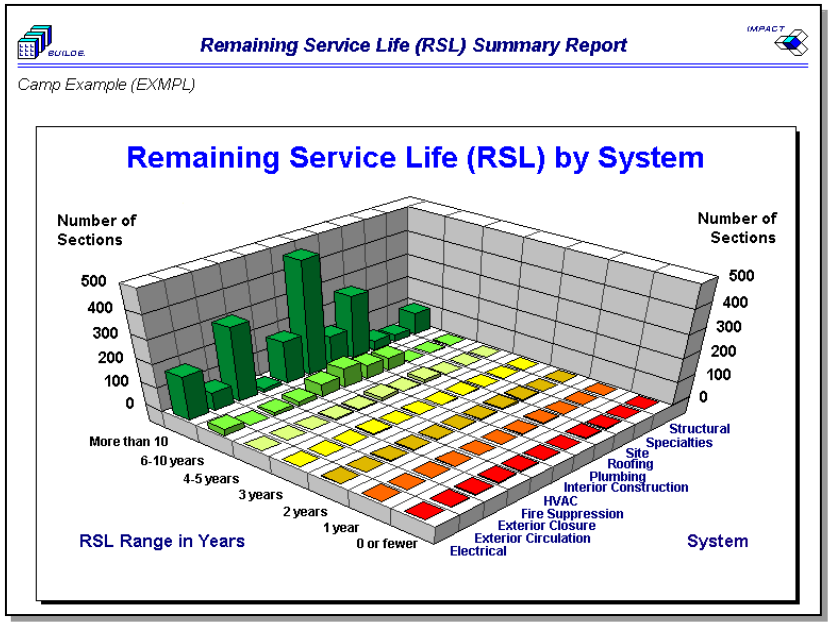




Condition Analysis/Prediction Results

- **Remaining Service Life Estimates**
- **Inspection Schedules**
- **Future work requirements**





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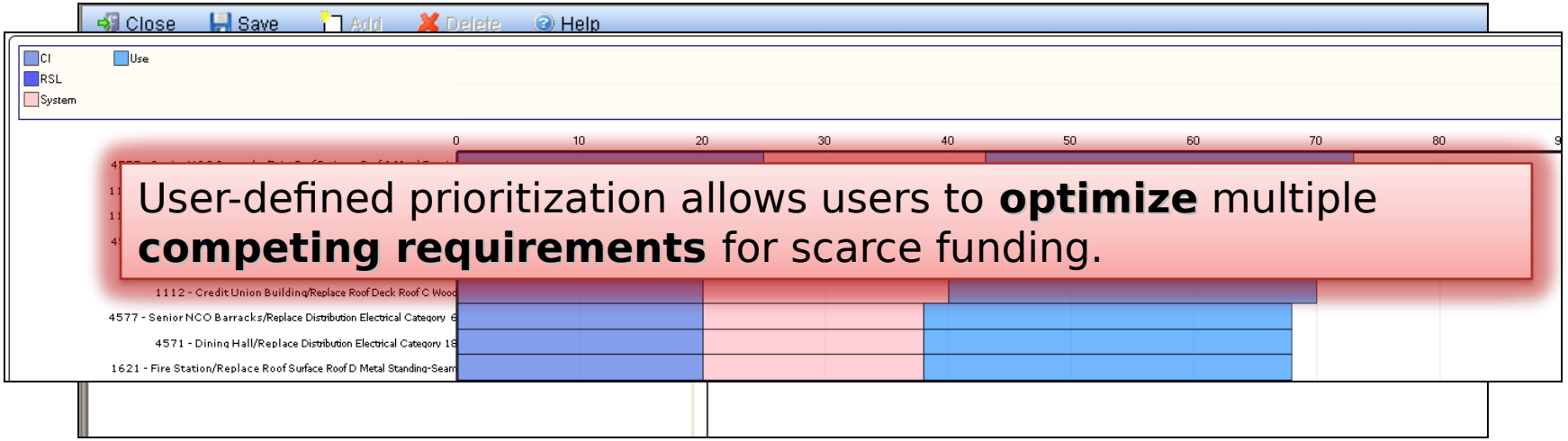
Work Planning

- **Work is automatically created based upon standards (thresholds)**
  - **Depending upon mission requirements, use rules to apply different standards to different assets**
- **Cost estimates are automatically calculated based on replacement costs**
  - **Repairs are modeled as percentage of replacement value**
  - **Repair vs. Replace calculations automatically performed to maximize ROI**
  - **Detailed cost estimates are available when assessment performed includes specific distress quantities**
- **FCI is automatically calculated based upon work generation rules and supplied funding amounts**

Work Prioritization

- **Funding resources are always constrained**
  - **Need prioritization to rank work requirements**
- **Use various parameters including economic, criticality, and geographic factors**
- **Focus work efforts on items most critical to mission accomplishment.**



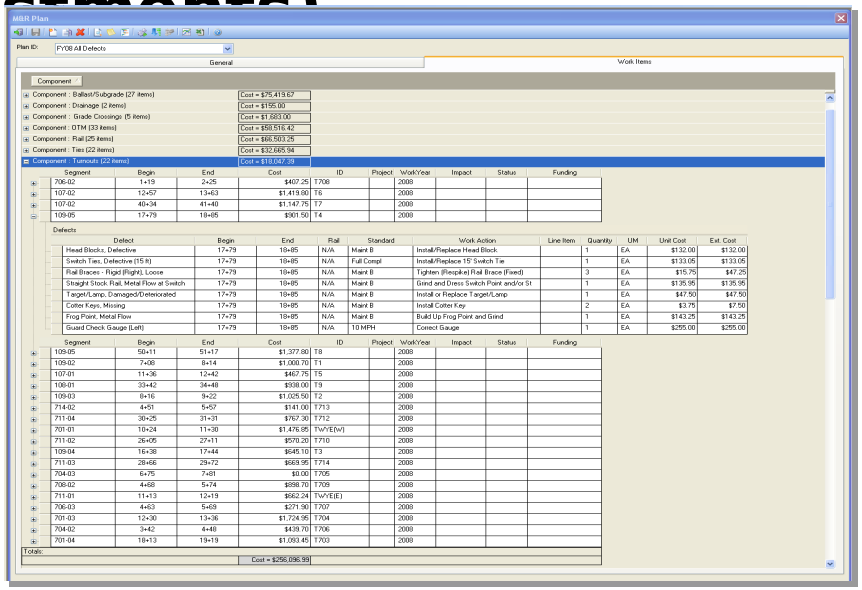
Work Planning Results

- **Annual work planning attached to specific assets (accountability and traceability)**
- **Work planning prioritized by mission requirements to direct scarce dollars against mission-critical needs (Mission-Focused Facility Investments)**

MR&R Analysis Summary

Ft. Riley (2007 Import) (20605) — ComplexInfo

Roof Section					Without Repairs			With Repairs			Recommendation		
Bldg	Section	Age	Fac Class	Area	RCI	Repl Year	Replace Cost	RCI	Repl Year	Repair Cost	Adj Ratio	Recmnd	Repl Year
0202	AA	2	Unacc	140	100	2027	847	100	2027	0	-	Replace	2027
0202	AB	2	Unacc	56	100	2027	339	100	2027	0	-	Replace	2027
0202	AC	2	Unacc	140	100	2027	847	100	2027	0	-	Replace	2027
0202	AD	2	Unacc	56	100	2027	339	100	2027	0	-	Replace	2027
0210	BA	2	Admin	1,516	100	2027	9,172	100	2027	0	-	Replace	2027
0210	BB	2	Admin	1,707	100	2027	10,327	100	2027	0	-	Replace	2027
0214	AA	-	Unacc	1,659	61	2011	10,037	61	2014	9,947	-	Replace	2011
0226	AA	7	Unacc	440	86	2013	2,662	100	2013	0	-	Replace	2013
0227	AA	5	Unacc	1,653	63	2009	10,000	84	2019	2,608	0.57	Repair	-
0227	AB	5	Unacc	778	87	2009	4,707	90	2009	0	-	Replace	2009
0227	AC	5	Unacc	243	79	2009	1,470	88	2021	871	-	Replace	2009
0227	AD	5	Unacc	243	86	2009	1,470	88	2009	0	-	Replace	2009
0229	AA	-	Suppl	1,282	74	2014	7,756	100	2029	825	0.34	Repair	-
0229	AB	-	Suppl	715	86	2017	4,326	90	2021	849	-	Replace	2017
0229	AC	-	Suppl	2,901	-1	2009	17,551	100	2009	0	-	Replace	2009
0391	A	4	Comm	511	100	2025	3,091	100	2025	0	-	Replace	2025
0406	AA	6	Opera	1,810	100	2026	10,950	100	2026	0	-	Replace	2026
0446	A	5	Unacc	467	100	2029	2,825	100	2029	0	-	Replace	2029
0446	B	5	Unacc	11,767	86	2011	71,189	100	2011	0	-	Replace	2011
0446	C	5	Unacc	2,891	88	2011	17,490	100	2011	0	-	Replace	2011
0446	D	5	Unacc	2,891	87	2011	17,490	100	2011	0	-	Replace	2011
0446	E	5	Unacc	6,650	90	2016	40,232	100	2016	0	-	Replace	2016
0446	F	5	Unacc	1,007	88	2016	6,092	100	2016	0	-	Replace	2016
0446	G	5	Unacc	140	88	2011	847	100	2011	0	-	Replace	2011
0446	H	5	Unacc	2,781	100	2024	16,825	100	2024	0	-	Replace	2024



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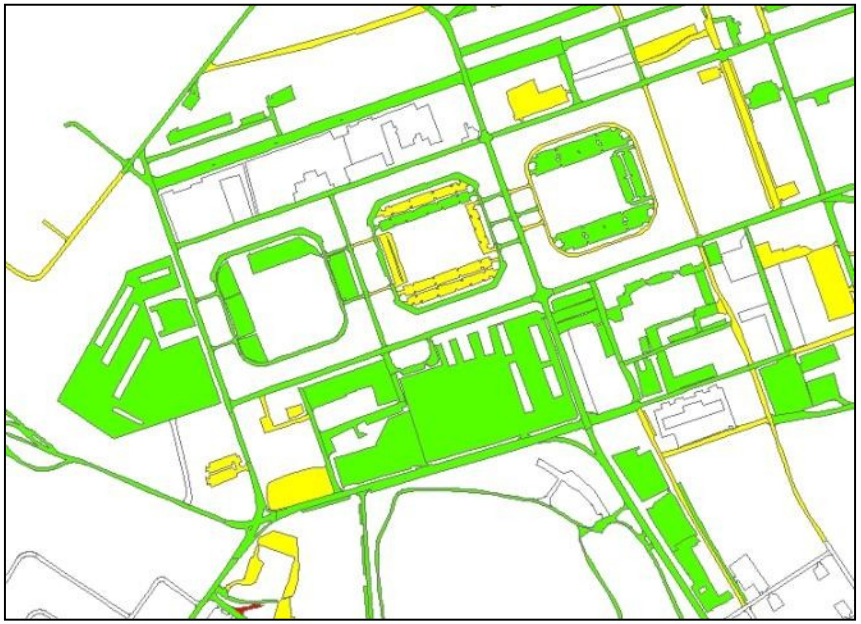
Forecasting

Forecasting is the same process as annual work planning, but repeated for multiple years over known inventory, behavior, policies, and funding.

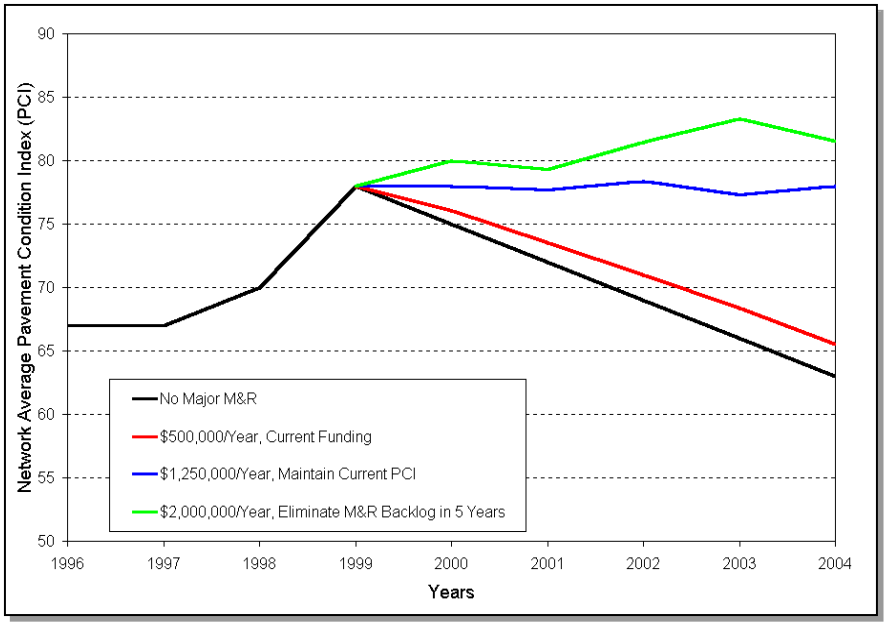
PCI after 5 years Stop-gap budget

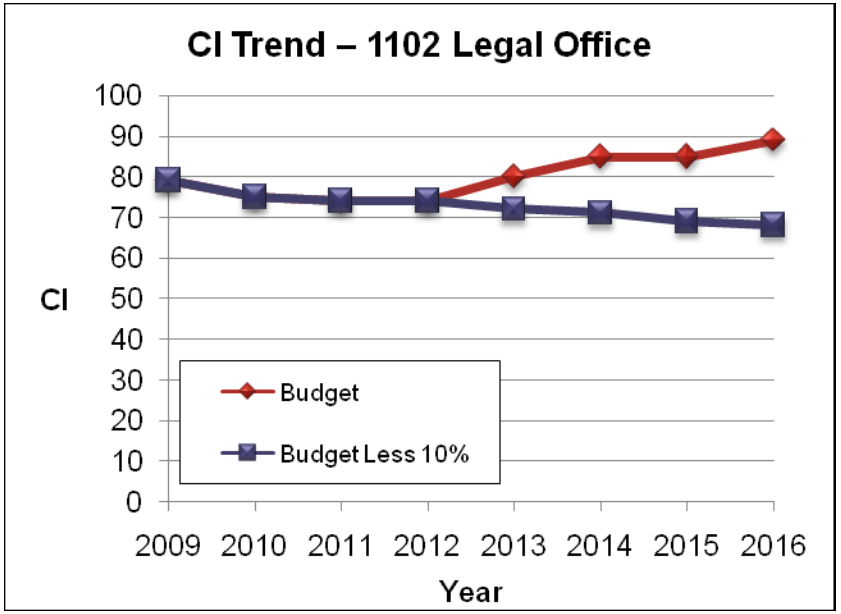
PCI After major M&R Backlog Elimination in 5 years



Forecasting (cont.)

- **Simulate the long-term impact on condition, performance, and estimated backlog**
- **Evaluate different scenarios (budgets, policies, prioritization schemes, etc)**





Forecasting Results

- **COA analysis and budget defense at all levels**
  - **OMB,**
  - **Congressional,**
  - **OSD,**
  - **Headquarters,**
  - **Command,**
  - **Region, and**
  - **Installation**
- **Out-year strategic condition trends**
  - **Will levels meet current or future mission requirements?**

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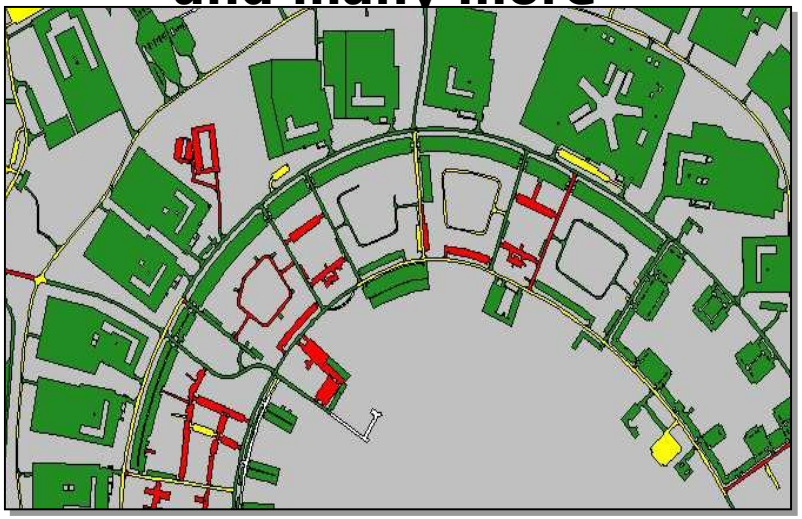
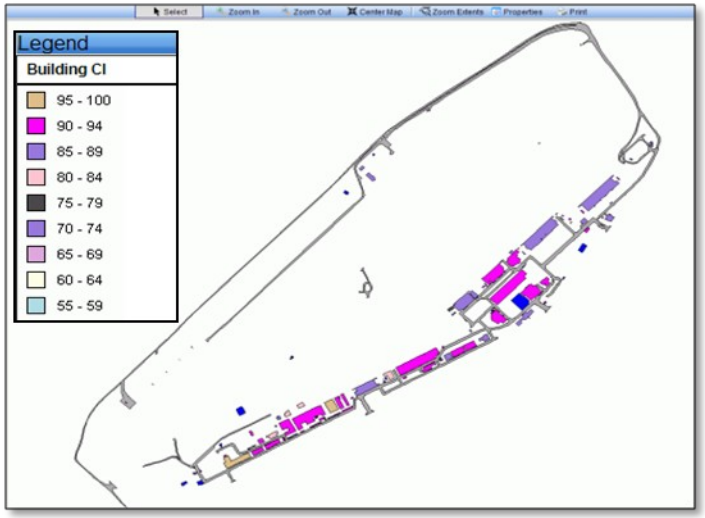
GIS

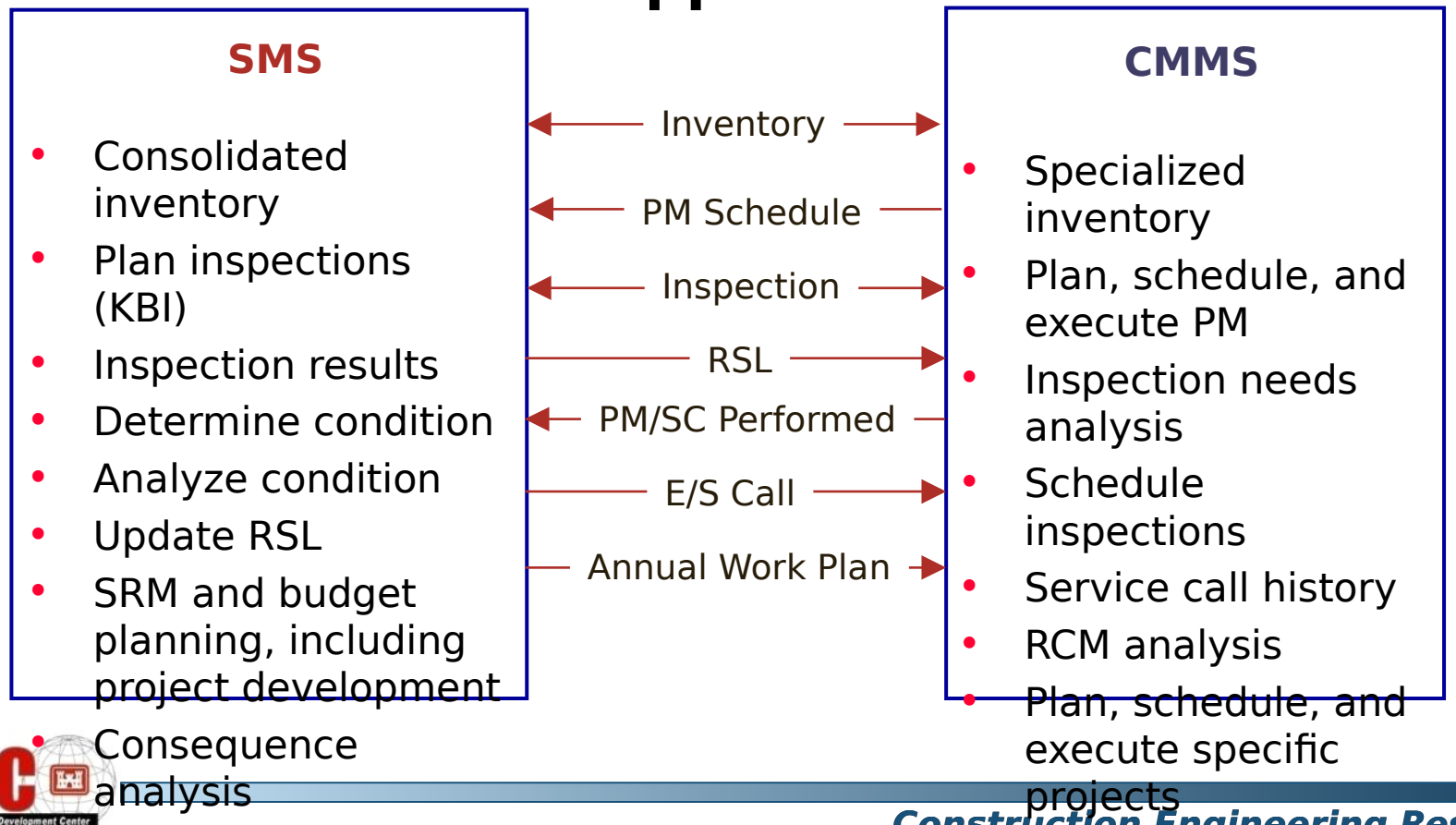
- **SMS Tools contain integrated or connected GIS solutions to query and display a variety of facility inventory, condition, and work planning information**
  - **CI,**
  - **RSL,**
  - **Work Costs,**
  - **and many more**





CMMS Integration

- **Work Planning and Work Execution have complementary roles**
- **Pursuing conceptual integration and data standards with support of OSD**



Agenda/Outline

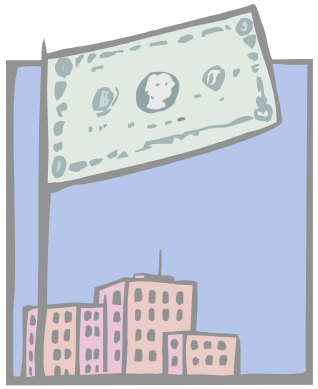
- ✓ **History**
  - Founded in Science
- ✓ **Inventory**
  - Systematic Process to breakdown inventory to right management level(s)
- ✓ **Assessment**
  - Objective, repeatable process to the right level of detail
- ✓ **Prediction**
  - Scientific self-adjusting modeling capability to forecast (models that learn)
- ✓ **Work Planning**
  - Systematic rational process to decide what work to do with mission and lifecycle optimization
- ✓ **Forecasting/Analysis**
  - Consequence awareness of decisions based upon financial and mission policies
- ✓ **GIS**
  - Quickly comprehend the situation through visualization
- ✓ **CMMS Integration**
  - Work Planning and Work Execution are complementary roles

THE RESULTS

Better management of the sustainment, restoration, and modernization of our infrastructure

- ✓ **Systematic, objective, efficient assessment of sustainment requirements**
- ✓ **Mission ready infrastructure**
- ✓ **Prioritized use of scarce resources**
- ✓ **Avoidance of future shocks**
- ✓ **Realistic, defensible budget projections**
  - **Avoidance of long-term penalties**
  - **Awareness of the consequences of today's**

Gather the right data at the right time at the right level for when you need the information.



Summary Discussion

QUESTIONS?